http://planetphysics.us/encyclopedia/CategoricalDynamics2.html

0.1 Introduction

Categorical dynamics is a relatively recent area (1958-) of applied algebraic topology/ theory and higher dimensional algebra concerned with system dynamics that utilizes concepts such as: categories, functors, natural transformations, higher dimensional categories and supercategories to study motion and dynamic processes in classical/ quantum systems, as well as complex or super-complex systems (biodynamics).

A type of categorical dynamics was first introduced and studied by William F. Lawvere for classical systems. Subsequently, a complex class of categorical, dynamic (M, R)–systems representing the categorical dynamics involved in metabolic–replication processes in terms of categories of sets and ODE's was reported by Robert Rosen in 1970.

One can represent in square categorical diagrams the emergence of ultra-complex dynamics from the super-complex dynamics of human organisms coupled *via* social interactions in characteristic patterns represented by Rosetta biogroupoids, together with the complex–albeit inanimate–systems with 'chaos'. With the emergence of the ultra-complex system of the human mind– based on the super-complex human organism– there is always an associated progression towards higher dimensional algebras from the lower dimensions of human neural network dynamics and the simple algebra of physical dynamics, as shown in the following, essentially non-commutative categorical diagram of dynamic systems and their transformations.

0.2 Basic definitions in categorical dynamics

Definition 0.1. An *ultra-complex system*, U_{CS} is defined as an object representation in the following non-commutative diagram of dynamic systems and dynamic system morphisms or dynamic transformations:

$$\begin{array}{ccc} [SUPER-COMPLEX] & \xrightarrow{\textbf{(Higher Dim)}} & (U_{CS} = ULTRA-COMPLEX) \\ \Big\downarrow \Lambda & & \Big\downarrow onto \\ COMPLEX & \xleftarrow[\textbf{(Generic Map)}]{} & [SIMPLE] \end{array}$$

One notes that the above diagram is indeed not 'natural' (that is, it is not commutative) for reasons related to the emergence of the higher dimensions of the super–complex (biological/organismic) and/or ultra–complex (psychological/neural network dynamic) levels in comparison with the low dimensions of either simple (physical/classical) or complex (chaotic) dynamic systems. Moreover, each type of dynamic system shown in the above diagram is in its turn represented by a distinct diagram representing its dynamics in terms of transitions occurring in a state space S according to one or several transition functions or dynamic laws, denoted by δ for either classical or chaotic physical systems and by a class of transition